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AD/RHIC-27

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RHIC Technical Note No. 27

Does Post Linac After Tandem Give More Gold in the RHIC

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August 11, 1987

DOES POST LINAC AFTER TANDEM GIVE MORE GOLD IN THE RHIC

Y. Y. LEE

There have been considerable discussions over whether it is advantageous to accelerate heavy ions after the Tandem before injecting into the AGS Booster. In this note, we compare possible senario of a post accelerating linac with the standard numbers in the RHIC conceptual design report except the afordable space charge tune shift could be .3 tune unit rather than .1 assumed in the report.

We consider two energies of post accelerator of 2.5 MeV and 4.5 MeV. We assume the charge state obtainable for each energy after striopping is three less than the ones given in G. R. Young's RHIC note(RHIC-PG-23 1983) --Experimentally it has been shown that the formula used by Young over estimates the charge state by about three--. Figure 1 is from Young's note and shows average charge state after stripping and efficiency at 200, 500, and 900 MeV correspong to 1, 2.5 and 4.5 MeV per nucleon. Table I summerizes the result of calculations.

TABLE I

The current available to inject into the Booste

	RHIC Stand.	2.5 MeV	4.5 MeV
Ion Source Current(p A)	200	200	200
Q at Tandem Terminal	13	13	13
Stripping efficiency(%)	19	19	19
Tandem Transmission(%)	75	75	75
Liac bunching efficiency(%)*	----	60	60
Final energy/Nucleon (MeV)	1	2.5	4.5
	.0463	.0729	.0976
Q final	33	45	52
Stripping Efficiency(%)	17	17	17
Final Current(p A)	5	3	3

*The number correspondes to the experience at AGS linac with two prebunchers. Prebunching with a chopper at the ion source would not help because one throwes out half the beam at this point.

Inorder to estimate the number of gold ions injected into the Booster we need futher assumptions. The maximum length of the Tandem pulse, and number of effective turns one can inject into the Booster. Since the emittance of the Tandem beam is sufficiently small compare to the acceptance of the Booster, injection efficiency or maximum number of the turn one can inject into the Booster is dominated by the thickness of the inflector septum. Other words injection is independent of the size of the final emittance of the incoming beam. The experience at the AGS proton injection shows up to 15 effective turns of the beam could be stacked out of twice as many actual turns injected. Since the emittance of the Tandem beam is much smaller than that of the proton linac beam, we like to assume up to 20 effective turns can be injected into the Booster. We assume the length of the Tandem beam pulse is sufficiently long enough to achieve maximum ions inside the Booster. The table II summerizes the result.

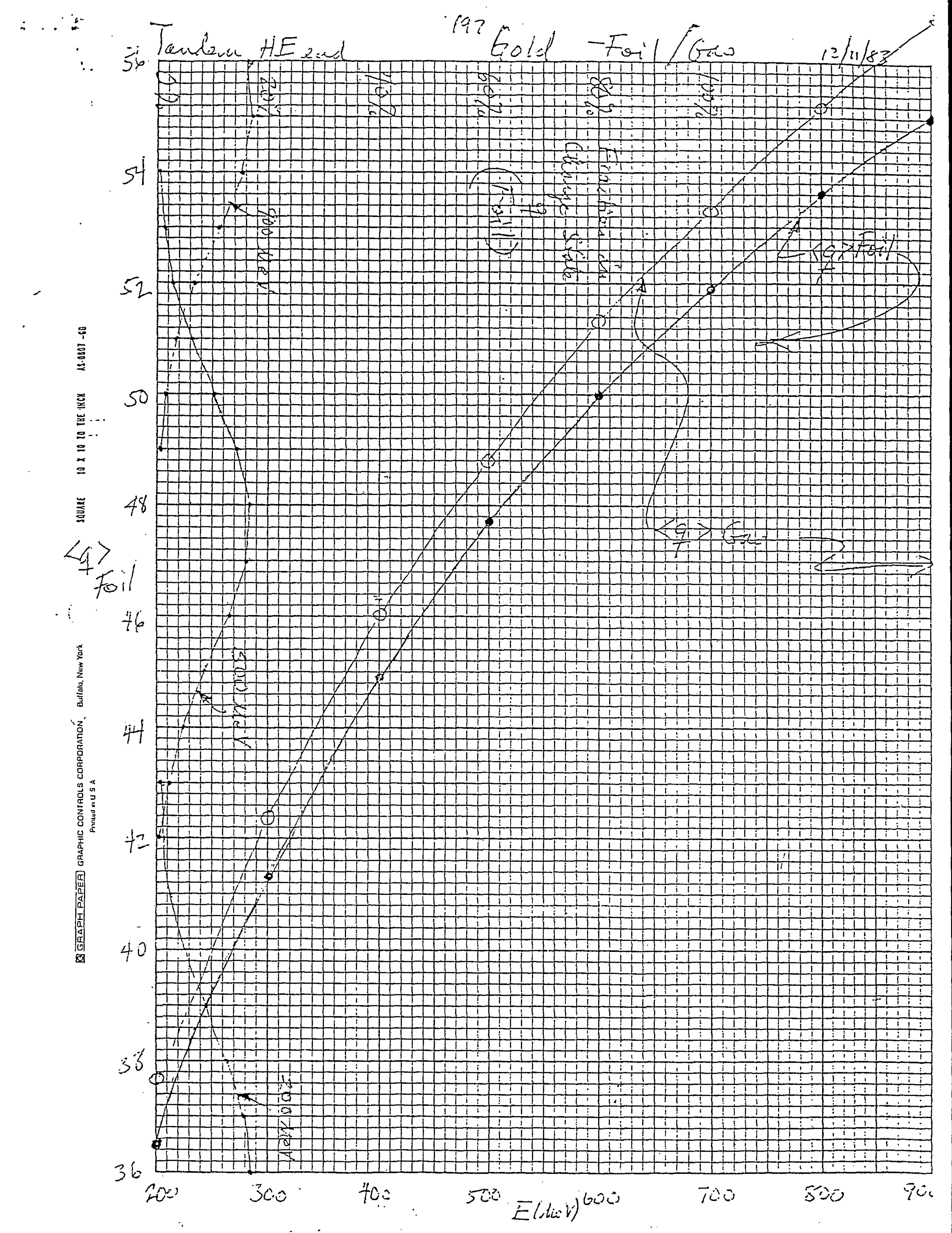
TABLE II

Number of gold ions available to inject into the RHIC

	RHIC Standard	2.5 MeV	4.5 MeV
Injecting Current($p\mu A$)	5	3	3
Revolution Time(μsec)	14.53	9.24	6.70
No. Ion in 20 Turns(10^9)	9.1	3.5	2.6
Space Charge Limit($\Delta\nu$ =.3)(10^9)	6.6	16.3	31.
Final Energy (MeV/Nucleon)	350	588	740
Stripping efficiency(%)	50	85	95
Ions for RHIC(10^9)	3.3*	3.0	2.5

*Space charge tune shift $\Delta\nu$=.3

As can be seen in the table, unless one improve the ion source current there is no advantage to post accelerate the ions prior to injecting into the Booster.



Tandem HE 2nd
197 Gold -Foil / Gas
12/11/83
% Fraction at Charge State
<q> Foil
<q> Gas
<197> Foil
(11-)
20%
40%
60%
80%
100%
600 keV
300 keV
200 keV
E (keV)
200
300
400
500
600
700
800
900
36
38
40
42
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GRAPH PAPER GRAPHIC CONTROLS CORPORATION Buffalo, New York
Printed in U.S.A.
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